CdTe portfolio offers commercial ready high efficiency solar

Abstract

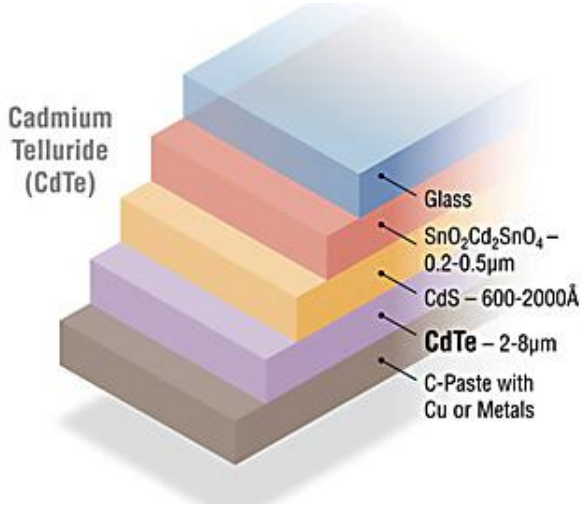
At production costs less than $.80/Watt, Cadmium Telluride (CdTe) thin film technology exists as the lowest cost per watt choice for solar technology. This is due partly to the single-phase nature of the absorber layer and the ease by which the CdTe source material can be formed into thin films needed to produce modules.

During the 20+ years of research, NREL's CdTe Group has directed their efforts at producing CdTe structures that allow more light to penetrate the top layers of the device to achieve high efficiency. Theoretical efficiencies for these devices are greater than 26% and laboratory efficiencies of 17% for a solar cell have been demonstrated by NREL.

The combination of low cost and increasing efficiencies have made CdTe based thin-film solar cell modules one of the fastest-growing segments of commercial production. Worldwide CdTe solar cell production has been predicted to increase to over 6,500 MW by 2015, 4X 2010 levels, with sales doubling during this same period to over USD $4 billion.

Technical Description

Thin-film CdTe solar cells are one of the most promising thin-film PV devices because their bandgap of 1.45 eV is an excellent match with the solar spectrum. Since these are direct bangap semiconductors with high absorption coefficient, only very thin absorber layers are required to absorb the photons.



Schematic illustration of a typical CdTe superstrate thin-film PV device. In this design, the layers of the device are deposited onto a glass "superstrate" that allows sunlight to enter. The sunlight passes through the glass and produces electrical current and voltage in the lower layers. The world-record NREL CdTe device is based on this structure and

A simplified method for fabricating a thin-film semi-conductor heterojunction photovoltaic device includes depositing a layer of cadmium stannate and a layer of zinc stannate on a transparent substrate, both by radio frequency sputtering at ambient temperature. This is followed by depositing dissimilar layers of semiconductors such as cadmium sulfide and cadmium telluride, and heat treatment to convert the cadmium stannate to a substantially single-phase, spinel crystal structure material. Preferably, the cadmium sulfide layer is also deposited by radio frequency sputtering at ambient temperature, and the cadmium telluride layer is deposited by close space sublimination at an elevated temperature effective to convert the amorphous cadmium stannate to the polycrystalline, spinel structure cadmium stannate.

Development Stage

This portfolio has been transferred to commercial processes currently used in producing high-performance modules

Availability

The intellectual property rights covering both the novel materials and methods of producing these materials are currently available for license. NREL has one remaining license for this method of producing high efficiency CdTel solar modules and is entertaining interested parties.

Sample Benefits

- Increase in efficiency
- Improved production yield

Potential Applications

- Low-cost solar module production (roll-to-roll processing).

Patents Included

NREL 96-49 US PATENT 5,909,632
Use of separate ZnTe interface layers to form OHMIC contacts to p-CdTe films

NREL 95-35 US PATENT 5,922,142
Photovoltaic devices comprising cadmium stannate transparent conducting films and method for making

NREL 98-39 US PATENT 6,137,048
Process for fabricating polycrystalline semiconductor thin-film solar cells, and cells produced thereby

NREL 97-21 US PATENT 6,169,246
Photovoltaic devices comprising zinc stannate buffer layer and method for making

NREL 95-45 US PATENT 6,221,495
Thin transparent conducting films of cadmium stannate

NREL 96-48 US PATENT 6,281,035
Ion-beam treatment to prepare surfaces of p-CdTe films

NREL 96-52 US PATENT 6,458,254
Plasma & reactive ion etching to prepare ohmic contacts

Technology Transfer Contact

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